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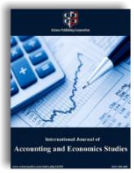

Does Colonization Affect Growth? An Empirical Comparative Study of Nine Asian Countries

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Abstract

The purpose of this study is to investigate the determinants of economic growth in nine Asian countries during two observation periods, namely from 1976 to 2021 for absolute convergence and from 2002 to 2021 for conditional convergence. The analysis employed three types: Pooled OLS, Fixed Effects (FEM) model, and Random Effects (REM) model. The results of this study's analysis indicate that government consumption, the ratio of exports to imports, and population have a significant influence on GDP growth per capita. Moreover, the existence of absolute and conditional convergence in several time periods explains the relationship with economic growth. The interaction between colonialism and the export-import ratio showed a significant positive influence, while the interaction with the rule of law showed a significant negative impact. The policy recommendations of this study are that we must continue to improve the efficiency of government spending, strategic investments in productive sectors, and legal reforms to create a conducive investment environment. This research underscores the need to expand the scope of data and adopt a more comprehensive methodology to investigate the dynamics of achieving sustainable economic growth in the future.

Keywords: *Convergence; Fixed Effect Model; Random Effect Model; Colonialism; Growth.*

1. Introduction

Economic growth in Asian countries shows similar characteristics, although there are many differences in growth rates. For example, Japan is experiencing rapid growth at an average annual rate of 10% (Ito, 2017). In the 1950s, countries in Southeast Asia were still focusing on government building and experienced slower growth during the same period. During this period, the primary focus of the economy in several Asian countries remained on the agricultural sector in rural areas, which tended to stagnate. However, countries such as Japan have already started to turn to the industrial sector and are experiencing rapid growth. The deregulation of the capital market in the 1980s did help stimulate real growth and maintain economic stability in several countries. However, this deregulation also brought several consequences, such as increased speculation and risk in the financial sector, which then triggered the financial crisis in several Asian countries in 1997/1998. The deregulation of the capital market offers a valuable lesson about the importance of striking a balance between economic growth, financial stability, and risk management. The government's unpreparedness for the threat of economic shocks, such as rapid technological developments, has resulted in the country remaining stagnant or being trapped in the group of middle-income countries. So that the government plays an important role in achieving a higher level of income (Acemoglu, 2001) (Susanto et al., 2025; Waoma, Izmuddin, et al., 2024; Waoma, Judijanto, et al., 2024). The impact of colonialism on economic growth remains a topic that warrants further empirical study. Previous studies conducted by Ito (2017), Acemoglu (2001), Barro (1996), Grier (1999), and Bertocchi & Canova (1996) have attracted attention to further study of how colonialism affects economic growth. Although the study conducted by the researchers mentioned above has a different research focus, there are similarities in examining these empirical facts. The study presented in this article aims to investigate the influence of colonialism on economic growth empirically. The study encompasses nine countries in Asia: China, India, Indonesia, Japan, South Korea, Malaysia, Nepal, Saudi Arabia, and Thailand.

The government must try to influence economic growth, in the form of this effort there needs to be an economic proxi approach that serves as a reference such as the quality of economic institutions and the protection of property rights, as revealed by the Ito (2017) study; Acemoglu (200), and Barro (1996), in addition to non-economic proxies such as democracy and state stability also need to be the focus to examine empirical studies from Mensah (2020); Bertocchi and Canova (1996). The proxies are then identified in the key variables of this study and juxtaposed with other variables. The goal is to see the relationship between these proxies in countries that have experienced colonization. In fact, some studies use the dummy for the colonial country, along with its variable instrument, namely the duration of

colonial rule (Grier, 1999; Bertocchi & Canova, 1996). The hypothesis of the relationship between colonialism and economic growth is based on the research of Harison (1985), who showed that colonialism significantly affects development patterns and that the identity of colonial forces is important for future growth.

This pattern of development can be explained one by one through the results of previous research, such as studies that show institutions formed during the colonial period have a significant long-term impact on economic development. Countries that are colonized in exploitative ways tend to inherit institutions that are weak and do not support property rights, and consequently hinder long-term economic growth. Barro's (1996) study traced various factors that affect economic growth in many countries, including colonial history. Although his focus was not specifically on colonialism, Barro found that good institutions (such as the protection of property rights) were essential to economic growth. Colonialism hurts the quality of institutions.

A study from Grier (1999) on the impact of French and British colonialism in Africa and Latin America shows that the former British colonies tend to have better economic performance compared to the former French colonies, because the British abandoned institutions that were more supportive of economic growth. In the same country, the study by Bertocchi and Canova (1996), which focused on Africa, found that colonialism had a significant long-term impact on economic development. The impact of colonialism can create economic structures that do not support long-term growth, as well as weak institutions and political instability. Meanwhile, the Ito (2017) study focuses on the issue of growth convergence and middle-income traps in Asia. Although he does not explicitly focus on colonialism, he highlights the importance of institutions and policies in achieving sustainable growth and escaping the middle-income trap. Based on the explanation above, this study aims to investigate how long-term economic growth is achieved in post-colonial countries, using the analysis approaches of absolute convergence and conditional convergence. These two analyses are crucial for obtaining a comprehensive understanding of whether the beta convergence hypothesis occurred during the period from 1976 to 2021. In addition, the independent variables used can explain their relationship to the dependent variables, and primarily how colonial status affects growth through interactions with these independent variables.

The structure of this article consists of only three main sections, namely Introduction, Discussion, and Conclusion. The remainder of the discussion section presents convergence theory, a literature review, the relationship between colonialism and growth based on the results of previous studies, research methods, and empirical findings. Meanwhile, the conclusion section reiterates the research results and offers recommendations and suggestions for future studies.

2. Discussion

2.1. Beta convergence

One of the important theories in development economics is beta convergence. The convergence discussion examines how per capita income shifts between regions or countries. There are two types of convergence, namely absolute and conditional convergence. Through absolute convergence, we can observe how low-income countries tend to grow faster, allowing them to catch up with high-income countries in terms of gross domestic product per capita (GDP per capita). As for conditional convergence, it argues that the economies of poorer countries grow faster than richer countries, provided that the two countries have similar fundamental factors (such as savings levels, education, and technology). However, rich countries that are well below the steady state, i.e., the condition where per capita growth is at a constant level, can also grow faster to reach the new steady state.

This model of convergence measurement can be derived through the neoclassical growth model, introduced by Cass (1965), Koopmans (1963), Ramsey (1928), and Solow (1956). The model looks at an inverse correlation between the per capita growth rate and the level of output or initial income. Especially if an economy has similar preferences and technology, poorer countries will grow faster than richer countries (Barro & Sala-i-Martin, 1992). So it can be said that these two factors drive the convergence of product levels and per capita income.

Many factors can affect beta convergence, including technology (Kumar & Russell, 2002), capital accumulation (Fatima et al., 2020; Sposi et al., 2021), education or human capital investment (Auer, 2015; Castelló-Climent & Doménech, 2022; Dore & Teixeira, 2022), international trade (Fatima et al., 2020; Sposi et al., 2021), and institutions (Castelló-Climent & Doménech, 2022; Dore & Teixeira, 2022). This factor is an attraction for researchers to see the convergence trend that occurs. In addition to these factors, some use the factors of colonization, climate change, and geography as variable instruments. Since the 1990s, empirical research has been conducted to test this theory (Barro & Sala-i-Martin, 1992; Islam, 1995). The empirical results obtained showed different beta convergences. The variety depends on the country or region of the research, the time period, and the analysis method used. However, research indicates that beta convergence is likely to occur in countries with high levels of economic integration and stable economic policies (Barro, 1996).

Based on the above literature explanation to empirically measure convergence between countries, the convergence equation can be written as follows:

$$(1/T) \cdot log(y_{iT}/y_{i0}) = x - [(/01 - e^{-\beta T}/T) \cdot log(y_{i0})] + [(1 - e\text{-}^{\beta T}/T) \cdot log\ \hat{y}_i^* + u_{i0,T} \quad (1)$$

Where ui0, T represents the effect of error terms, uiT, between periods 0 and T (the steady-state level of income), and . $\hat{y}_i^*$x (state growth) is assumed to be the same for all economies. $1 - {}^{e\text{-}T\beta T}$ is the initial income parameter and will decrease with the length of the interval T, for a given: the longer the average time, the smaller the estimated coefficients. Growth convergence means b < 0. From this equation, it can be interpreted that the higher the current per capita income level below the stable state level, the higher the growth rate.

2.2. Literature review

Since the introduction of the income convergence theory in macroeconomics by Solow (1956) through the neoclassical growth model, many researchers have begun to study the phenomenon regionally and across countries. The research results are also diverse. These differences in results may be due to differences in the country or research region, year, and variables used. The researchers attempted to update the results of the research from those previously conducted by Barro & Sala-i-Martin (1992) and Islam (1995). However, the interesting aspect of this contemporary study is that, despite varying time spans and sample country numbers and types, convergence results can be demonstrated between countries.

Furuoka (2019) examines whether CLMV countries (Cambodia, Laos, Myanmar, and Vietnam) are successfully catching up with their income lag compared to older ASEAN members, such as Indonesia, Malaysia, the Philippines, Singapore, and Thailand. The study's results

showed that CLMV countries experienced a relatively higher increase in income compared to other countries in Southeast Asia. This indicates that this group of low-income countries is catching up with them in the ASEAN region. One of the key factors supporting this convergence is the growing economic integration between countries, increased foreign direct investment, and the increasingly open economic policies in the CLMV group of countries.

Mensah's study (2020) found that there was no absolute convergence in the three groups of countries observed: Europe, Asia, and Sub-Saharan Africa. This means that developing countries cannot catch up with developed countries in terms of per capita income without considering additional factors. However, he found strong evidence of conditional convergence when factoring in factors such as investment, population growth, and human capital. This suggests that countries with similar socio-economic characteristics tend to converge in their per capita income levels over time.

Convergence research in China has been studied by Li & Fang (2018) and Jiang (2014). Both studies found evidence of economic convergence among provinces in China. This means that poorer regions tend to grow faster than richer ones, leading to a reduction in regional economic disparities. Although they both obtain the same results, they employ different methods. Li and Fang (2018) employed a spatial econometric approach to demonstrate that spatial interactions between regions have a significant influence on economic growth and convergence. Meanwhile, Jiang (2014) uses a dynamic panel data approach. They also recognize the importance of geographical factors and proximity between regions in their analysis.

Cohen and Soto (2007) examined convergence in MENA countries with a focus on human capital. Using a data panel approach, the study's results indicate that education and investment are key drivers of the region's convergence. Other studies, such as AlAdlani (2019) and Malik and Masood (2022), also examined the same region. Malik and Masood (2022) found that the productive factors used as variables, namely, physical capital, human capital, and total productivity, were proven to exhibit convergence in most MENA countries over the long term. Meanwhile, in the short term, the variable that contributes positively to income per worker is physical capital. Meanwhile, AlAdlani (2019) utilized governance indicators, including political stability, government effectiveness, quality of regulations, effective law enforcement, and corruption control, to demonstrate a positive impact on economic growth in MENA countries. Thus, long-term economic growth can be achieved if the state has successfully built solid and accountable institutions.

Johnson et al (2018) and Wahiba (2015) examined income convergence between countries. The results showed that convergence was evident during the observation period. However, the convergence that occurs is not uniform and is neither sustainable nor continues indefinitely (Johnson et al., 2018). Two independent variables, namely the quality of institutions and trade policies, were found to encourage convergence in the study country (Fatima et al., 2020; Dore & Teixeira, 2022). Countries with more open policies and better institutions tend to experience faster convergence. Open policies and better institutions encompass various characteristics and practices that support economic growth and income convergence between countries, including open trade and effective law enforcement (Johnson et al., 2018; Wahiba, 2015). Overall, both studies emphasize the significance of institutional, economic, and structural factors in shaping the process of income convergence between countries. While there is evidence of beta convergence, the challenges in achieving convergence suggest that income inequality remains a significant issue that requires addressing with appropriate policies and reforms.

In addition, studies have also examined income inequality in several countries, as discussed by Arčabić et al. (2021), Ivanovski et al. (2020), and Solarin et al. (2023). A study conducted by Solarin et al. (2023) using data from 21 OECD countries, as well as stationary panel testing on time series data, yielded empirical results indicating absolute, conditional, and sigma convergence. In conditional convergence, it is found that two structural factors drive convergence: economic growth and population. On the other hand, research conducted by Arčabić et al. (2021) found that income inequality in the United States actually diverged. During the study period from 1917 to 2012, it was found that convergence occurred only in the sub-sample from 1932 to 1985. The driving factors for the convergence that occur in the state are determined by human capital and government policies. This means that government policies, such as redistribution and increased access to education, can help reduce inequality. Even tax benefits on the sale of capital gains tax assets can help convergence, as it is considered one of the most efficient policies.

In contrast to Solarin et al. (2023) and Arčabić et al. (2021), Ivanovski (2020) employed structural breaks to find that the quality of income in Australia converges to a steady state when changes occur at any time, including trend-breaks. Among all the Australian states observed, only the state of Victoria did not experience convergence to stable conditions. This is because the situation is sensitive to structural breaks. This income inequality arises from the economic transition from manufacturing to a service-based sector, as well as changes in government welfare and tax policies (Arcabic et al., 2021).

Other studies, such as those by Auer (2015) and Castelló-Climent & Doménech (2022), examine convergence through the role of human capital. Meanwhile, Kumar and Russell (2002) and Suidarma et al. (2019) view technological changes as contributing to the convergence of economic growth. The dynamic influence of trade has a significant impact on divergence, while static trading actually benefits convergence (Auer, 2015). However, the trade resulted in increased income inequality due to the shift in education from poor to rich countries, driven by the efficiency of skills. Meanwhile, if you focus solely on human capital development, the convergence of a country's per capita income increases (CastellóClimen & Domenech, 2022). Thus, countries with higher levels of human capital tend to experience faster economic growth. From a technological perspective, Kumar and Russell (2002) estimated the growth of 57 countries during the period 1965-1990 using three components of labor productivity: technological change, technological catch-up, and capital accumulation. The results of the study show that of the three components, only technological changes have a positive and significant influence on growth. This result is because productivity growth between countries exhibits different patterns based on the contributions made by both low-income and high-income countries. Meanwhile, Suidarma et al. (2019) conducted research on ASEAN+3 countries, specifically China, South Korea, and Japan, from 2001 to 2015. Using the Arellano-Bond Generalized Method of Moments (GMM) dynamic panel analysis method, the results of the analysis revealed that technology plays a significant role in achieving conditional beta convergence.

2.3. Colonization and economic growth

The global income gap remains a topic of ongoing discussion among economists. This gap certainly did not happen overnight or even in the last few centuries. Because what we feel today may be influenced by a long historical process, specifically the era of colonialism. Through this article, I aim to explore the impact of colonial influence on economic growth. My interest in researching this matter is based on the results of reading primary references on colonialism and economic growth, including Barro (1996), Bertocchi & Canova (1996), Grier (2016), Acemoglu et al. (2000, 2001), and Ito (2017). The research results reveal diversity, indicating that colonialism can also influence economic growth and potentially contribute to income disparities. According to a study by Barro (1996), which used democracy as a proxy for colonial status in its analysis, democracy may have an indirect impact on the standard of living, life expectancy, and education. Additionally, colonial status also influenced economic growth through the implementation of specific policies and institutions. The institutions currently in place share the same characteristics as those that existed during the colonial era (Acemoglu et al., 2001). So

why are institutions considered important? Research shows that countries with "institutions" that are good at managing wealth, compliance with regulations, trade openness, and policies in accordance encourage physical and human capital investment to generate high income (Barro, 1996; Acemoglu et al., 2001). In fact, these factors not only attract investors to invest in a country but also encourage economic exchange, namely international trade (Yu et al., 2015). However, when associated with colonial influences, studies by Lavallée & Lochard (2015) show that independent countries tend to reduce trade with former colonial countries. Instead, the country chooses to trade with other countries by considering geographical factors. Head et al. (2010) examined the impact of independence on post-colonial trade. Although there was little short-term effect on trade, after four decades, trade with the metropole (the colonizer) had decreased by about 65%. Hostile separations led to significant and direct reductions in trade. We also find that trade between former colonies of the same empire decreased by as much as trade with the metropole, while trade with third countries decreased by about 20%. The gradual decline in trade after independence suggests a decrease in a specific form of trading capital.

Another study from Bertocchi and Canova (1996) examined the impact of 20th-century European colonization in Africa. Research shows that growth in the Portuguese, Belgian, and Italian colonies tends to be slower than in other colonies, such as those of the United Kingdom and France. Following decolonization, Africa's economy experienced a faster average rate of growth. In contrast, Grier (1999), using a sample of 63 former colonial countries from 1961 to 1990, found that countries colonized over a long period tended to experience better development and growth on average after independence. Even after independence, education became a key driver of many developments, particularly in the former British and French colonies in Africa. According to the regression results, it is also noted that government consumption growth has a negative and significant relationship with the real growth of average income (Barro, 1996). This means that during the research period, government consumption plays a dominant role in development. The impact in the future will be that private activities will decrease or even be replaced, resulting in lower private investment and less efficient resource utilization.

In the Asian region, the study of Ito (2017) observed the growth of convergence in East Asia. After grouping countries into three groups based on income, the results showed that low-income countries experienced a similar convergence in growth. Meanwhile, middle-income countries are caught in the middle-income trap, making it challenging to jump-start the pursuit of convergence towards stable conditions. Studies suggest that middle-income countries should implement policy reforms, particularly by enhancing innovation, including technological advancements. Through technology, these countries can develop into industrialized nations. If reforms are not implemented, the economy will continue to stagnate, essentially falling into the trap of middle-income countries.

2.4. Methodology

Data and Data Sources

This empirical research aims to determine whether colonialism has an impact on economic growth in Asian countries. To answer this question, this study utilized panel data from 9 selected countries: China, India, Indonesia, Japan, South Korea, Malaysia, Nepal, Saudi Arabia, and Thailand. This selection is based on the completeness of data during the period 1976-2021 to obtain an absolute convergence analysis. All variables used in this study are sourced from the World Development Indicators and Worldwide Governance Indicators (Castelló-Climent & Doménech, 2022; Fatima et al., 2020; Ouedraogo et al., 2022). Then, a conditional convergence analysis was conducted using data from the 2002-2021 period. This period range is also based on the availability of data for any of the variables that will explain the purpose of the study. At absolute convergence, data spanning a total of 46 years will be converted into nine observation sub-samples, with an average of 5 years per country, except for the period 2016-2021, which will be 6 years. The result of this conversion is the loss of information every year between countries because the variation drives the best results by ignoring the time variation of each country (Grier, 1999).

Determination of Variables

The research will utilize research variables that have been previously employed in studies by Barro (1996), Grier (1999), Fatima et al. (2020), and Ouedraogo (2020). The dependent variable used is the average value of GDP growth. Meanwhile, the independent variables are government final consumption expenditure, government consumption, fertility rate, and life expectancy. Other variables to address the research objectives include the ratio of exports and imports, compliance with the rule of law, and dummies to form interactions between countries that have experienced colonialism and those that have never experienced colonialism. The descriptions for each variable, definition, and data source are presented in Table 1.

The selection of this variable is based on previous literature references. In addition to the availability of data, the country selection is also used to determine the year of the research period's beginning, especially for the rule of law variable. According to the World Governance Indicators data, data on the complete rule of law in 9 selected countries began in 2002. Therefore, the treatment of this variable estimation causes other variables to be estimated as well, from 2002 to 2021, to produce the best analysis results.

Table 1: Variable Description, Definition, and Data Source

Variabel	Definition	Source
GDP Per Capita (Constant 2015US$)	GDP per capita is calculated by dividing the gross domestic product by the mid-year population. GDP is the sum of the aggregate value added by all domestic producers in the economy, plus any product taxes, and minus any subsidies that are not included in the value of the product.	WDI
Initial GDP	As in previous research, I used data on initial GDP, derived from the average value of income per capita (GDP per capita in constant terms), to explain subsequent GDP growth (Grier, 1999).	-
Government Consumption	The government's final consumption expenditure is the total cost incurred by the government to purchase operational goods and services (including employee salaries). It covers most of the defense and security budget, but does not include military costs for building or upgrading military infrastructure (investments).	WDI
Fertility Rate	The total fertility rate represents the average number of children a woman would have over her lifetime if she followed a birth pattern based on the age-specific fertility rate in a given year.	WDI
Life Expectancy	Life expectancy at birth indicates the number of years that the average newborn can expect to live if the pattern of death that applies at birth remains the same throughout their life.	WDI
Populasi	The total population is based on the definition of de facto population, which counts all residents regardless of legal status or nationality. The values displayed are mid-year estimates.	WDI
Rasio Export-Import	This ratio is calculated based on the results of the export ratio and import ratio derived from World Bank data. This ratio reflects international trade, especially for developing countries. The calculation of this ratio is based on the ratio of export prices to imports, measured as a percentage of GDP.	WDI
Rule of Law	The conditions of law enforcement and security in a country. This is seen from the extent to which the contract is enforced, the ownership of	WGI
Dummy Colonialism	Protected, the police and the courts are trusted, as well as how high the likelihood of a crime occurring.	

	Data categories to distinguish countries that have been colonized and have never been colonized. Countries that have been colonized are given a score of 1, and countries that have never been colonized are given a score of 0.

Estimation Models and Analysis Methods

This research model will examine absolute convergence using Equation 1. For conditional convergence, models 2, 3, 4, and 5 are employed. Models 2 and 3 below show the relationship between initial GDP, government consumption, fertility rate, life expectancy, population, and export-import ratio to average GDP growth with the equation:

$$y_i = \beta_0 + \beta_1 initial\_GDP_i + \beta_{2+} government\_consumption_i + \beta_3 fertility\_rate_i$$

$$+ \beta_4 life\_expectancy_i + \beta_5 population_i$$

$$+ \beta_6 ratio\_exim_i + \beta_7 rule\_of\_law_! + \varepsilon_i \quad (2)$$

$$y_{it} = \beta_0 + \beta_1 initial\_GDP_{it} + \beta_2 government\_consumption_{it} + \beta_3 fertility\_rate_{it}$$

$$+ \beta_4 life\_expectancy_{it} + \beta_5 population_{it} + \beta_6 ratio\_exim_{it}$$

$$+ \beta_7 rule\_of\_law_{it} + \gamma_i + \gamma_t + \varepsilon_{it} \quad (3)$$

Where y is the variable representing the average GDP growth adjusted for the analysis's needs, i represents the country, and t indicates the observation time. The difference between statements (2) and (3) is the time entered for the data panel. Thus, γi represents the country fixed effect, and γt is the time period fixed effect. This treatment is also applied to equations (4) and (5). Model (2) will be analyzed using the Ordinary Least Squares (OLS) developed from the models of Acemoglu et al. (2001), Castelló-Climen and Domenech (2022), and Li and Fang (2018), while model (3) with Data Panel was developed from Dore and Teixeira (2022) and Islam (1995). This analysis process is conducted to obtain the best estimation results in the conditional convergence analysis. Between OLS and Data Panel, panel data estimation tends to produce better parameters in explaining the influence of each variable than OLS. Based on the third test, the estimated results indicate that the regression with the Fixed Effect Model method is considered more appropriate than the Random Effect Model.

Meanwhile, the following models (4) and (5) are used to see the relationship between initial GDP, government consumption, fertility rate, life expectancy, population, export and import ratio, rule of law, and dummy colonialism to the average GDP growth with the equation:

$$y_i = \alpha_0 + \beta_1 initial\_GDP_i + \beta_2 government\_consumption_i + \beta_3\ fertility\_rate_i$$

$$+ \beta_4 life\_expectancy_i + \beta_5 population_i + \beta_6 ratio\_exim_i$$

$$+ \beta_7 rule\ of law_i + \beta_8 (dummy\_colonised * ratio\_exim)_i$$

$$+ \beta_9 (dummy\_colonised * rule\ of\ law)_i \quad (4)$$

$$y_i = \alpha_0 + \beta_1 initial\_GDP_{it} + \beta_2\ government\_consumption_{it} + \beta_3 fertility\_rate_{it}$$

$$+ \beta_4 life\_expectancy_{it} + \beta_5 population_{it} + \beta_6 ratio\_exim_{it}$$

$$+ \beta_7 rule\ of\ law_{it} + \beta_8 (dummy\_colonised * ratio\_exim)_{it}$$

$$+ \beta_9 (dummy\_colonised * rule\ of\ law)_{it} + \gamma_i + \gamma_t + \varepsilon_{it} \quad (5)$$

Then, in model (3), we will examine whether the variables of the ratio of exports and imports, the rule of law, and the interaction of these two with the dummy variable influence the average GDP growth, from the results of the estimation obtained between the OLS model and the second fixed effect compared to which one is better at explaining each variable and answering the objectives of this study. Then, based on the third test value, it is stated that the fixed-effects model is considered more appropriate than the random-effects model.

Reasons for selecting country samples. A sample of nine Asian countries was selected to reflect variations in colonial experiences and economic growth patterns. Countries with extreme resource dependence (e.g., large oil exporters) have been carefully evaluated. Countries like Brunei were excluded because their economic growth was largely determined by the rent of natural resources rather than by colonial institutional inheritance.

2.5. Empirical results

This section presents a summary of descriptive statistics for each variable used in the analysis process. The data presented are a summary of the variables for absolute convergence and conditional convergence analysis for equations 1, 2, and 3 from 1976 to 2021. For the variables in the conditional convergence analysis for equations 4 and 5, the data span from 2002 to 2021.

Table 2: Descriptive Statistics 1976-2021

Variabel	Mean.	Std. Dev.	Min.	Max.	Obs.
GDP per capita	9202.4	10628.4	326.9	36138.5	414
GDP growth rate	0.033	0.045	-0.28	0.12	405
GDP initial	8.26	1.44	5.79	10.5	405
Consm Government	24.21	2.13	18.42	28.66	414
Population	18.4	1.52	15.9	21.1	414
Fertility rate	2.79	1.41	0.8	7.3	414
Life expectancy	69.83	7.98	45.5	84.6	414

Ratio Ex-Im	1.02	0.30	0.13	2.46	414
Rule of law	0.133	0.67	-0.96	1.6	180

Note: the variables converted into natural logarithms are GDP per capita and Government consumption. Meanwhile, the other variables use data obtained from WDI and WGI.

Table 2 shows the statistical description of each variable used in the analysis process for the countries in the sample. From the table, it can be seen that the average GDP growth per capita is 0.033 percent with a standard deviation of 0.045. The minimum average growth rate of -0.28 percent was recorded in Saudi Arabia in 1982, while the maximum of 0.12 percent was achieved in China in 1984. Oil prices influence the fluctuations in GDP growth in Saudi Arabia. The oil boom has a significant influence on the economy. Therefore, it is not surprising that, during the 1980s and 1990s, the average growth rate of real GDP per capita was negative (Al-Sadiq, 2014).

Government final consumption expenditure has an average of 24.21 percent with a standard deviation of 2.13. The lowest expenditure of 18.42 was recorded in Nepal in 1978, and the highest value of 28.66 was observed in China in 2021. In 1976, Nepal initiated the Integrated Rural Development Projects (IRDP) program to coordinate and support development initiatives, with a focus on meeting the basic needs of rural communities. The program aimed to improve the living conditions of rural populations, particularly in hilly areas. In addition, China has experienced a drastic increase in government spending due to the response to the COVID-19 pandemic, domestic economic stimulus, infrastructure investment, and defense and security (UNDP, 2022). The population has an average of 18.4 with a standard deviation of 1.52. The country with the highest population is China, at 1.3 billion, and the country with the lowest population is Saudi Arabia, at 15.9 million. The fertility rate has an average value of 2.79% with a standard deviation of 1.41%. The country with the lowest average fertility rate is South Korea at 0.8 percent, while the highest is Saudi Arabia at 7.3 percent. The average life expectancy is 69.83 years, with a standard deviation of 7.98. The country with the lowest life expectancy, based on observations, is Nepal at 45.5 years, while the highest life expectancy is in Japan, at 84.6 years. Japan's high life expectancy is primarily attributed to a significant decline in deaths from infectious diseases, cancer, and pneumonia. This is also driven by the perfect and orderly diet of the people, which includes foods such as vegetables, fish, meat, milk, and other dairy products (Tsugane, 2021).

The ratio of exports to imports is one of the indicators used to show a country's foreign trade deficit. From the results of the descriptive analysis for the export-to-import ratio, an average value of 1.02 with a standard deviation of 0.30 was obtained. The country with the highest ratio is Saudi Arabia, at 2.46 percent, while the country with the lowest ratio of exports to imports is Nepal, at 0.13 percent. The legal compliance variable has an average of 0.133 with a standard deviation of 0.67. The country that effectively implements the principles of law, namely, where the people and institutions of the state adhere to the rules, is Japan, with a maximum score of 1.96. On the other hand, Nepal, which lacks in terms of the rule of law, has a score of -0.96.

Absolute Beta Convergence

This section presents the estimated results using Equation 1 for the convergent absolute across the study country sample. As explained in the methodology section, the estimation for the absolute value is divided into two models: the OLS model and the Data Panel model. These results illustrate the relationship between the average rate of GDP growth per capita and the initial GDP per capita. The results of the analysis are presented in Table 3 below.

Table 3 presents the results of the analysis using three pooled OLS, fixed-effects, and random-effects models. These three models show absolute convergence in 9 countries. Estimates from the Pooled OLS model can show absolute convergence for all years of observation. In the sub-sample group of periods, three time periods experience absolute convergence, namely from 1981-1985, 2006-2010, and 2011-2015. In the Data Panel from the results of the third test carried out, a statistical value of Sargan-Hansen was obtained with a probability of 0.0041, meaning that we reject the null hypothesis and conclude that the fixed effects model is more appropriate because there is a systematic difference between the coefficients of the fixed effects model and the random effects.

Table 3: Comparison of OLS Regression Results and Data Panel

	Pooled OLS		Fixed Effect		Random Effect			Number
Period	Initial R-	Initial R-	Obs of GDP squared	GDP squared	GDP squared		Countries	
1976-80	-0.003	0.0143	-0.302*	0.2674	-0.004	0.2674	36	9
	(-0.006)		(-0.114)		(-0.006)			
1981-85	-0.023*	0.2149	-0.012	0.0012	-0.023	0.0012	45	9
	(-0.009)		(-0.041)		(-0.017)			
1986-90	0.002	0.0039	-0.075	0.0278	0.002	0.0278	45	9
	(-0.005)		(-0.093)		(-0.005)			
1991-95	-0.006	0.0531	-0.006	0.0005	-0.006	0.0005	45	9
	(-0.004)		(-0.031)		(-0.008)			
1996-20	-0.007	0.031	-0.316	0.1566	-0.007	0.1566	45	9
	(-0.004)		(-0.147)		(-0.005)			
2001-05	-0.005	0.0456	0.049	0.0182	-0.005	0.0182	45	9
	(-0.003)		(-0.041)		(-0.005)			
2006-10	-0.012**	0.1657	-0.102*	0.082	-0.014*	0.082	45	9
	(-0.004)		(-0.036)		(-0.006)			
2011-15	-0.007***	0.1634	-0.054	0.0569	-0.007**	0.0569	45	9
	(-0.002)		(-0.051)		(-0.003)			
2016-21	-0.007	0.0564	-0.288*	0.2428	-0.008**	0.2428	54	9
	(-0.004)		(-0.098)		(-0.003)			
All periods	-0.008***	0.058	-0.012*	0.0293	-0.011*	0.0293	405	9
	(-0.002)		(-0.005)		(-0.005)			

Notes: Standard error in parentheses. The numbers bolded in black indicate the significance of robustness at the level of * p<0.05, ** p<0.01, *** p<0.001
Source: World Development Indicator

Based on fixed-effects testing, very little absolute convergence occurred during the observation time period, even after grouping by sub-sample. Absolute convergence occurs in most cases, as in OLS estimates, but in different time periods, specifically between 1976-1980, 2006-2010, and 2016-2021, with a significance level of 5 percent in each period. This is in accordance with the convergence hypothesis, where to accept the null hypothesis about the existence of absolute convergence β, the slope coefficient must be negative and significant. Thus, there is a tendency for poor countries to grow faster than rich countries, so the absolute convergence hypothesis applies. Barro (1991) and Haider et al. (2010) obtained similar results. The lack of evidence for this absolute convergence was also noted in previous literature by Mensah (2020) and Romer (1986).

Figure 1 presents an overview of the relationship between growth and average per capita income in the nine countries observed. The numbers in the picture represent the following countries: 1. China, 2. India, 3. Indonesia, 4. Japan, 5. South Korea, 6. Malaysia, 7. Nepal, 8. Saudi Arabia, and 9. Thailand. The negative relationship between the growth rate from 1976 to 2021 and the logarithm of per capita income in 1976 is shown in Figure 1. From Figure 1, it is evident that poorer countries are striving to catch up with richer countries.

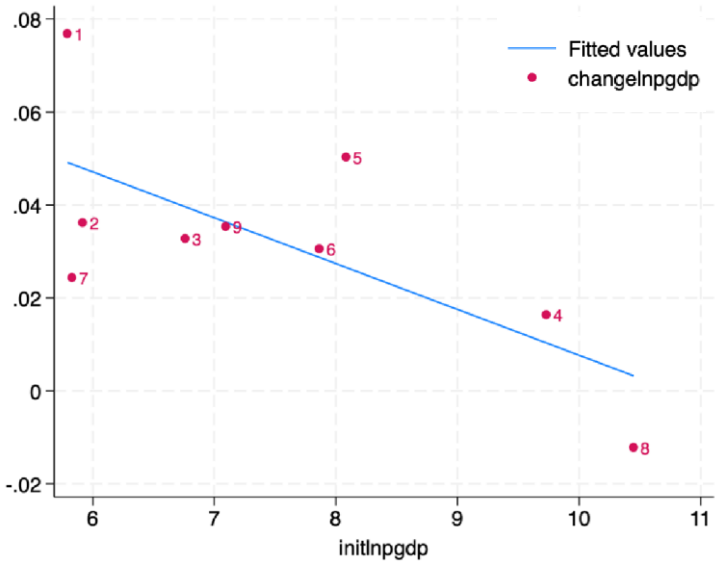

Fig. 1: Convergence of Revenue Growth with Start-Up Income in 9 Countries

Conditional Beta Convergence

Table 4 presents the average growth rate in nine countries from 2002 to 2021. This conditional convergence is carried out to complete the absolute convergence analysis and see whether environmental variables affect the rate of income growth in each country.

Table 4: Comparison of OLS Regression Results and Data Panel with Robust

Variabel	OLS M2 β/s.e	FEM M3 β/s.e	REM M3 β/s.e
lnpgdpl1	-0.003	-0.124**	-0.061*
	(-0.014)	(-0.028)	(-0.026)
lngov	-0.007	0.050**	0.024*
	(-0.008)	(-0.01)	(-0.011)
fer	-0.017*	-0.034*	-0.027**
	(-0.008)	(-0.011)	(-0.009)
life	0	-0.003	-0.002
	(-0.002)	(-0.003)	(-0.004)
lnpop	0.014	-0.116***	-0.023
	(-0.009)	(-0.02)	(-0.016)
ratio_exim	0.028*	0.044*	0.056***
	(-0.013)	(-0.019)	(-0.016)
rule_of_law	-0.008	0.025	0.019
	(-0.005)	(-0.016)	(-0.013)
Constant	-0.01	2.216***	0.576*
	(-0.137)	(-0.373)	(-0.265)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	No	Yes	Yes
Obs.	180	180	180
R-squared	0.3136	0.2256	0.1711
Number of Countries	9	9	9

Notes: Standard error in parentheses, lnpgdpl1 is the initial GDP per capita, lngov is the natural logarithm for government consumption, fer is the fertility rate, life is life expectancy, lnpop is the number of population in natural logarithms, ratio_exim is the ratio of exports to imports, and rule_of_law is the rule of law. OLS M2 is an analysis conducted with pooled ordinary least squares on model 2. FEM and REM M3 are analyses carried out with fixed and random effects on model 3. The numbers bolded in black indicate significance at the level of * p<0.05, ** p<0.01, *** p<0.001
Source: World Development Indicator.

The estimation in Table 4 is conducted to examine the differences in the results between the robust model and the non-robust model. In the table, several differences are evident, ranging from significant variables to the consistency of the coefficient results. The fixed-effects model, with and without robustness, shows that the variables lnpgdpl1, lngov, fertility, and the export-import ratio have a significant influence. Meanwhile, the random effects model has a difference between being robust and not. Without robust variables, significant variables include fertility, life expectancy, and the export-import ratio, while with robust variables, fertility is not significant. Models that are robust to standard errors are generally more reliable. This is because the model has corrected heteroscedasticity problems that often arise in the data panel. If you look at the R-squared value, there is consistency in the results across all models. Among the fixed effects and random effects tests, based on the analysis results, the Fixed Effects Model (FEM) with robust standard errors is the more suitable choice. This is because FEM addresses interunit variability issues that Pooled OLS or REM cannot capture.

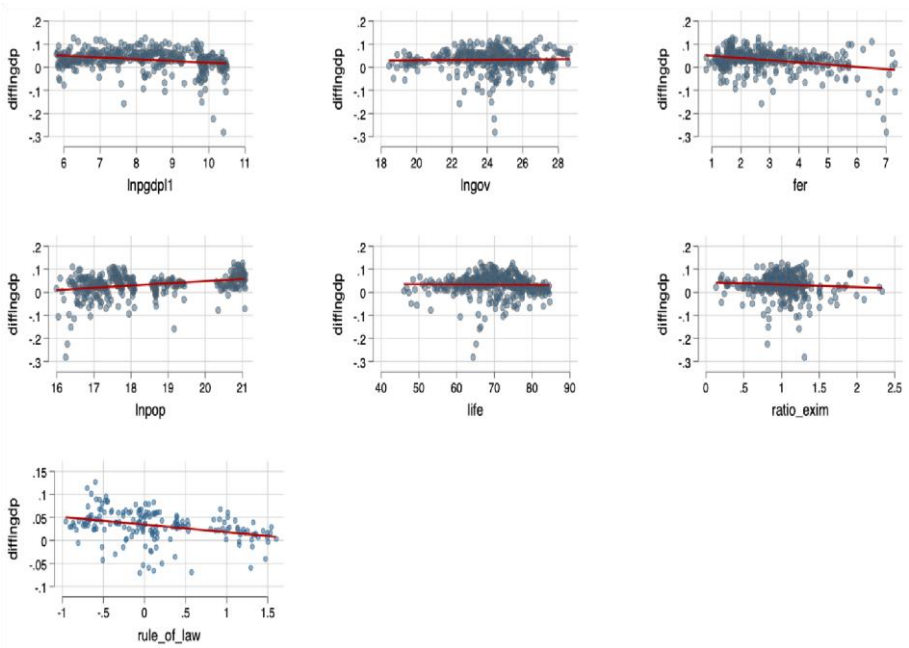

Fig. 2: The Relationship of the Growth Rate with All Independent Variables in the Observation.

Figure 2 presents the relationship between the growth rate and each independent variable analyzed. The horizontal axis displays the observation variables, adjusted for the year of analysis, ranging from 1976 to 2021, except for the rule of law variable, which spans from 2002 to 2021. This growth rate has been filtered to estimate the effects of explanatory variables other than the GDP per capita logs shown in column 5 of Table 4. Conceptually, this image illustrates the estimated effect of all variables on subsequent growth, assuming all other explanatory variables are held constant. The graph indicates that the estimation relationship is not significantly affected by outlier observations and exhibits no apparent deviation from linearity. A similar construct will be used for each of the explanatory variables.

Variabel	OLS M4 β/s.e		FEM M5 β/s.e		REM M5 β/s.e	
lnpgdpl1		0.003	-0.128** (-0.03)			0.003
		(-0.014)				(-0.024)
lngov		-0.007	0.047**			-0.007
		(-0.008)	(-0.011)			(-0.011)
fer		-0.017*	-0.035*			-0.017
		(-0.008)	(-0.012)			(-0.01)
life		-0.002	-0.001			-0.002
		(-0.002)	(-0.003)			(-0.003)
lnpop		0.015	-0.116**			0.015
		(-0.009)	(-0.027)			(-0.013)
ratio_exim		0.028*	0.055**			0.028
		(-0.012)	(-0.014)			(-0.017)
rule_of_law		-0.014*	0.039			-0.014
		(-0.005)	(-0.019)			(-0.008)
coldexim		-0.009	-0.131**			-0.009
		(-0.005)	(-0.032)			(-0.008)
colrule		0.028***	-0.048* (-0.02)			0.028***
		(-0.006)				(-0.007)

Table 5: Comparison of OLS Regression Results and Data Panel with Robustness

Constant	0.035	2.290**	0.035
	(-0.13)	(-0.531)	(-0.187)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	No	Yes	Yes
Obs.	180	180	180
R-squared	0.3663	0.266	0.0641
Number of Countries	9	9	9

Notes: Standard error in parentheses, lnpgdpl1 is the initial GDP per capita, lngov is the natural logarithm of government consumption, fer is the fertility rate, life is life expectancy, ratio_exim is the ratio of exports to imports, and rule_of_law is the rule of law. OLS M4 is an analysis performed using pooled ordinary least squares on model 4. FEM and REM M5 are analyses carried out with fixed and random effects on model 5. The numbers in bold black indicate significance at the level of * p<0.05, ** p<0.01, *** p<0.001. Source: World Development Indicator

Table 5 shows that several significant variables are present in all models. The variables lnpgdpl1 and lngov were significant in FEM but not in OLS or REM. Then, the interaction between colonialism and the rule of law was significant in OLS and REM, but with different coefficient directions in FEM. In addition, the FEM model shows a significant influence of several variables that are not seen in OLS and REM. This suggests that models that account for the fixed effects of the state can capture variations not captured by the OLS and REM models. Based on these results, if the state effect remains considered significant, the FEM model may be better suited for this analysis than OLS or REM. The fixed-effects model is a more appropriate method when dealing with countries that have their own unique characteristics. The main advantage is that the term intercept is allowed to vary between individual units (states) but remains constant over time.

Through this table, we can understand the influence of independent variables on dependent variables in different contexts, taking into account the fixed effects of the panel data. The study's results showed conditional convergence in the countries examined. The coefficients associated with the initial GDP per capita log were negative and statistically significant at the rate of 1%. This suggests that countries in these regions are converging towards their steady-state income levels. Therefore, conditional convergence applies to the selected countries in the sample.

The results of this study also show a positive and significant relationship between government spending and per capita GDP growth for the entire sample and all sub-regions. This aligns with prior expectations. In theory, the impact of government spending on growth depends on the effect of productivity (Karras, 2001). Government consumption is expected to have a negative influence on growth because low consumption can increase the productive effect of private spending, which encourages growth. However, this analysis revealed a significant positive relationship between the two variables. This means that the increase in government consumption hurts growth. If government consumption is high, it can negatively impact growth by reducing private sector economic activity.

A growing population has a significant positive relationship with economic growth. However, the study's results found evidence that population has a negative and significant influence on GDP growth per capita. Population growth is another important variable that affects economic growth. Solow's model predicts that a higher rate of population growth will lead to lower per capita income in a steady-state stable state (Solow, 1956). This is evident in the analysis, where the impact on growth is negative due to the high rate of population growth that exceeds the technological pace in the region. If the population is growing, then some economic investment is used to provide capital for new workers, rather than increasing capital per worker. Therefore, a higher rate of population growth negatively impacts y*, i.e., a stable rate of output per effective worker in the neoclassical growth model. The high birth rate reinforces this negative impact. This means that an increasing amount of resources must be allocated to raising children, rather than to the production of goods and services. Regression in the FEM column showed a significant negative coefficient of -0.116 (-0.027) in the natural logarithm of the total population (Mensah, 2020). This result differs from Grier's (1999) finding, which indicated that population variables had a positive and significant effect. Barro's research (1996) uses the term terms of trade to indicate the ratio of exports to imports. This variable is often considered an important factor influencing the development of countries that generally specialize in exporting primary products. Suppose the physical quantity of goods produced domestically remains unchanged. In that case, an increase in the terms of trade will increase real domestic income and possible consumption, but will not affect real GDP. Changes in real GDP occur only if shifts in terms of trade encourage changes in employment and domestic output.

Hasil pada kolom 2 model FEM Tabel 5 menunjukkan koefisien positif yang signifikan pada rasio ekspor impor 0.055 (-0.014). Dengan demikian, peningkatan rasio ekspor impor cenderung mendorong peningkatan output domestik. Hasil positif dan signifikan ini sejalan dengan hasil penelitian yang dilakukan oleh (Barro, 1996; Frankel & Romer, 1999; Harrison, 1996).

In the interaction variable, it can be seen that the coefficient has a negative value. Therefore, it can be said that the difference between countries that have been colonized and have never been colonized is associated with the interaction variable (dummy with the ratio of exports-imports) to the dependent variable, which is -0.131 (-0.032). The relationship of these variables to countries that have been colonized is lower than that of countries that have never been colonized, ceteris paribus. This means that the value of the negative coefficient indicates that the country that has been colonized receives an impact on the economy, in this case, proxied by the ratio of exports and imports (Head et al., 2010).

The rule of law variable, when analyzed directly in relation to growth, shows insignificant positive results. This suggests that the rule of law may have a positive influence on growth; however, the statistical evidence is not strong enough to warrant a significant impact in a model that considers only these variables. However, when interacting with dummy colonialism. The results of these interactions showed a negative and statistically significant influence, with a coefficient of -0.048 (-0.02). This means that, in the context of countries that have been colonized, the rule of law variable correlates with a decrease in average GDP growth. This estimate means that a decrease in the rule of law by one unit of standard deviation (-0.02) can reduce the average growth rate by 0.02 units. This suggests that colonized countries exhibit a low level of legal compliance, resulting in a significantly adverse effect on income during the observation period. With an R-squared value of 0.266, the model exhibits a pretty good fit in explaining the influence of variables across the sample.

3. Conclusion

The results of descriptive statistical analysis and regression analysis revealed several important findings related to economic growth and the factors influencing it in the nine sample countries during the observation period. GDP growth per capita has an average of 0.033 percent with a standard deviation of 0.045, showing significant variation between countries and periods. In addition, government consumption, export-to-import ratios, and population were also found to have a significant influence on GDP growth per capita. The Fixed Effects (FEM) model is more suitable than other models because it can capture variations between countries that are not accounted for in the Pooled OLS or Random Effects (REM) model. This analysis demonstrates the existence of both absolute and conditional convergence across several time periods, supports the hypothesis that poorer countries tend to grow faster than richer countries, and highlights the significance of environmental variables in driving economic growth. High government spending, a rapidly growing population, and favorable export-import ratios have a positive influence on GDP growth per capita, although the effects vary across different analysis models. The negative impact of population growth on GDP per capita highlights the challenges faced by countries with high population growth rates in achieving sustainable economic growth. Additionally, the interaction between colonialism and the export-import ratio revealed a significant positive influence, affecting trade dynamics and income growth. Meanwhile, the interaction between the variables of colonialism and the rule of law revealed a negative impact on growth, suggesting that colonial history and compliance with the law had a detrimental effect on economic growth. Overall, the results of this study offer valuable insights into the factors that influence economic growth in developing countries, underscoring the importance of policies that promote a stable and productive economic environment.

Based on the findings of this study, several policy recommendations can be taken to encourage sustainable economic growth in developing countries. Governments should enhance the efficiency of spending and investment in productive sectors, such as education, infrastructure, and health, which have a lasting impact on economic growth. In addition, efforts to increase the ratio of exports to imports, such as through diversification of export products and improving the quality of goods, must also be intensified. Legal reform and improved good governance are essential to create an environment conducive to investment and trade.

This research has several limitations that need to be considered. First, the limitations of the available data may not reflect all variables that affect economic growth, such as other factors that are difficult to quantify. Second, a limited observation period may not be enough to capture the long-term dynamics of economic growth. Therefore, further research is recommended to expand the scope of data, both temporally and in terms of variables used, as well as to employ a more comprehensive methodological approach. Researchers are also

encouraged to examine the impact of interactions between economic and non-economic factors more closely, as well as consider using richer panel data to capture variations between countries and time periods more effectively. Moreover, Limitations that further research could expand on this analysis after the 2025 data is officially released.

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